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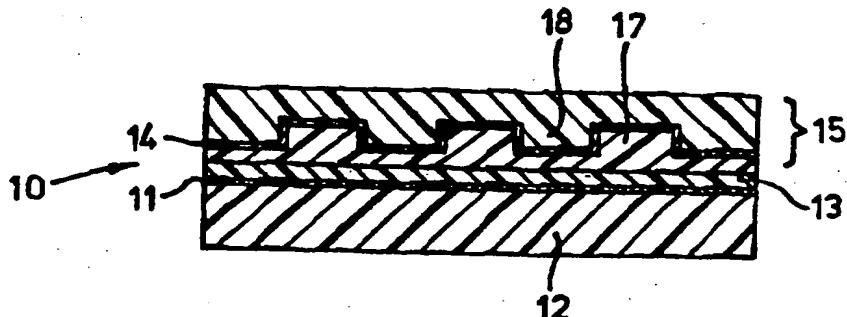
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(71) Applicant (for all designated States except US): GPT AXXICON B.V. [NL/NL]; Kanaaldijk Z.W. 7B, Postbus 237, NL-5700 AE Helmond (NL).	
(72) Inventor; and	
(75) Inventor/Applicant (for US only): ESHUIS, Donald [NL/NL]; Adriaen Poirterslaan 22, NL-5582 EP Waalre (NL).	
(74) Agent: DE BRUIJN, Leendert, C.; Nederlandsch Octrooibureau, Scheveningseweg 82, P.O. Box 29720, NL-2502 LS The Hague (NL).	

(54) Title: PROCESS FOR PRODUCING AN OPTICAL INFORMATION CARRIER AND OPTICAL INFORMATION CARRIER

(57) Abstract

Process for producing a disc-shaped information carrier (10), such as a CD or DVD, provided with a central opening and optically readable information which is arranged (can be arranged) around this opening. This information carrier is built up by providing various layers by injection-moulding which are then attached to one another. At least a substrate (12) and a label (13) are present. Prior to the injection-moulding, the label may be prepared with visually apparent images and/or (laser) optically readable information and/or semiconductor chips. In this case, the visually apparent image is present on the label, optionally on the side facing the substrate. It is possible to provide a further optical information carrier part in which exclusively or in which in addition optical information is stored.



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PROCESS FOR PRODUCING AN OPTICAL INFORMATION CARRIER AND OPTICAL INFORMATION CARRIER

The invention relates to a process for producing a disc-shaped optical information carrier, provided with a central opening and 5 optically readable information which is arranged (can be arranged) around this opening, comprising the provision of a substrate and the arrangement thereon of readable information, the substrate being produced by injection-moulding.

Such a process is generally known for the production of CDs. In 10 this process, a plastic part, which is provided on one side with the desired elevations and recesses (pit structure or optically readable information), is produced by injection-moulding or compression moulding. By then making this side essentially light-impermeable, for example by 15 sputtering on a metallic layer, it is possible to read out the optical information. A protective layer may be applied by spin-coating. The same side of the CD is generally provided by conventional techniques with information which is directly visible to the user. The number of steps required to obtain a CD is consequently relatively great. The same drawbacks apply if DVDs are to be produced.

20 The object of the present invention is to arrange existing and new characteristics of the information carrier, or semi-finished products, in a more expedient manner. These characteristics may relate to graphic information, such as text and images, but may also relate to 25 readable information, such as pit structures and erasable and rewritable materials, encryptions, protective layers, attachment layers and reflection layers, as well as information stored in semiconductor chips.

This object is achieved for a process as described above in that this readable information is arranged on a label, this label is placed in the cavity of an injection mould, followed by the full 30 injection of this cavity with the material for the substrate.

Semi-finished products and finished products can be produced by using a label which is made, for example, of polycarbonate. Semi-finished products have one or more characteristics of the information carrier. Information carriers with new characteristics are formed by combinations 35 of semi-finished products. The use of a label which is made, for example, from polycarbonate film means that there are scarcely any limitations with regard to printing techniques and possibilities. Moreover, pirating of the information carrier is impeded, owing to the fact that it will not be easy for a counterfeiter to follow the above-described procedure. The

above advantage can be increased substantially by making use of certain encryption techniques which are customary in the production of protected printed material, such as holograms, kinegrams, interference patterns, etc.

5 The desired arrangement of information and/or further characteristics on the substrate can be provided in one production step using the technique of in-mould labelling.

According to an advantageous embodiment of the invention, the substrate is made from polycarbonate material, PMMA, polystyrene, 10 polyester or other suitable plastics.

According to an advantageous embodiment of the invention, the label is provided with optically readable characteristics before being placed in a mould cavity. Moreover, it is possible to employ readable semiconductor chips or an image based on an interference pattern. Also, 15 there is the possibility of employing optionally selectively reflecting layers. All such embodiments are considered to fall within the expression "optical characteristics".

If the optical information carrier is to be writable/readable, it is necessary for it to be provided with writable/readable structures 20 or materials, such as an organic dye. A dye of this kind can be applied particularly well in suspension to the above-described label. In this manner, it is possible to achieve a writable CD very simply.

During the production of the writable CD, it is possible to apply the dye to that side of the label against which injection is to 25 take place in the mould. In that case, the CD in principle comprises a substrate and a label, the interface comprising the writable organic dye. However, it is also possible to construct an optical information carrier of this kind from two parts. In this case, the first part comprises the abovementioned substrate and the label, but the writable organic dye is 30 arranged on the mould side of the cavity. By then injection-moulding a further part and fastening it to that side of the label which is provided with dye, it is also possible to obtain a writable optical information carrier.

For CDs and DVDs in which the optical information is fixed 35 during production, the optical information can be applied by various methods.

The information carrier to be produced can be achieved by realizing a finished product in one production step or by combining different semi-finished products in accordance with the process described

above.

The simplest embodiment is that in which only a substrate and a label are used. In that case, the optical information is situated in the region of the interface between substrate and label. A particular 5 embodiment is obtained if the label is provided in advance with the relevant optical information, the side which contains the optical information being placed such that it faces the cavity of the injection mould, whereupon the substrate is then injection-moulded onto the label. Using particular printing techniques, it is possible to arrange optically 10 readable digital information on the label.

However, it is also possible to arrange the information such that it is not, or not exclusively, at the substrate/label interface. A design of this kind can be achieved by providing an optical information carrier part. For example, it is possible to produce an optical 15 information carrier part of this kind in one or more separate steps and then to fasten an assembly, comprising substrate and label, thereto. In this case, the label is placed between the substrate and the further optical information carrier part. The graphic information which is directly visible to the user is then no longer situated on the surface of 20 the CD or similar optical information carrier, but rather is situated between the at least two parts forming the optical information carrier. It is also possible to achieve a slightly three-dimensional effect by means of the distance between the free surface of the CD and the readable information. Moreover, it is possible to arrange (optionally in advance) 25 interference-based images, such as holograms and the like, at such locations, the label acting as the carrier. This provides a further obstacle to the pirating of CDs and assists the recognizability of the information carrier. The further optical information carrier and the label can be attached to one another by any method known in the prior 30 art. However, it is possible to provide the label with a layer of adhesive, for example an ultraviolet light-activatable adhesive, which adhesive is not activated during the injection-moulding owing to the absence of ultraviolet light. When the substrate provided with a label and the optical information carrier part are then placed together and 35 subjected to ultraviolet radiation, these two parts can bond together.

It is also possible to provide one or more semiconductor chips on the assembly comprising substrate and label, which chip(s) is/are optionally fastened to the label beforehand. Furthermore, it is possible to add substances for characteristics other than those mentioned above to

the assembly comprising substrate and label, which substances are necessary for the operation or production of the information carrier, such as reflection materials and fillers. As a result, the number of process steps for producing the information carrier after the injection-moulding is reduced.

It must be understood that it is also possible for exclusively the optical information carrier part to be provided with optical information and the substrate and the label not to be provided with optical information. It is also possible for the label employed, irrespective of the characteristics, to have smaller dimensions than the information carrier.

It will be clear from the above that numerous further variants are possible. This number is increased further if one considers that it is also possible to use techniques in which more than one information layer is read from one side, i.e. various information layers are arranged one behind the other. In this case, the layer situated closest to the surface may be essentially light-transmitting for a light source having a first light frequency, the light originating from this light source being sensitive to the information situated beneath this. Light from a second light source having a second frequency is not able to pass through the first layer, from which it is reflected and read out. Another possibility consists in the use of two lenses with focal points situated at different depths and one type of light or one light source. A so-called "2P-resin" may be incorporated between two such layers. The in-mould labelling according to the invention makes it possible to limit considerably the number of process steps for producing both CDs and DVDs and/or to achieve characteristics which it has hitherto been impossible or very difficult to apply.

The invention will be explained in more detail below with reference to the exemplary embodiments depicted in the drawing, in which:

Fig. 1 shows a writable optical information carrier, the various layers being depicted separately from one another;

Fig. 2 shows a partial cross-section of a DVD, in which the information is stored on one side;

Fig. 3 shows a second embodiment comprising two layers of information which can be read out from one side;

Fig. 4 shows an embodiment with two layers which can be read out from the top side and the underside, respectively; and

Fig. 5 shows an embodiment with four optical information

carriers.

The optical information carrier according to the invention is denoted overall by 1 in Fig. 1. It comprises a substrate 2 which is produced by injection-moulding. A label 3, which is provided with a layer 4 of organic material which enables the information carrier to be writable, is arranged on this substrate 2. A translucent layer 5 is arranged on this layer 4. The entire assembly is provided with an opening 6.

The above-described optical information carrier is produced by 10 producing part 5 in a first injection-moulding step. In another, independent injection-moulding step, label 3 is placed in the cavity of the injection-moulding machine, layer 4 bearing against the wall of the cavity. Synthetic material, such as polycarbonate, is then injected and layer 2 is formed. This means that in practice layer 2 and 3 are always 15 attached to one another. This combination of layers 2 and 3 is attached to layer 5 in a manner known in the prior art. In this manner, a writable/readable optical information carrier is formed.

The process can be simplified by omitting the layer 5. In such a case, the layer 4 of organic material is not situated on the side of 20 layer 5 of label 3 but on the side of substrate 2.

It is also possible to produce a CD which can only be read in a particularly simple manner. Proceeding from a label 3 in accordance with Fig. 1, provided on that side which subsequently adjoins substrate 2 with digital readable information, such as elevations and recesses, produced 25 using specific techniques, this label is placed in an injection mould. Substrate 2 is then injection-moulded against this label. The other, free side of the label 3 may be provided with information which is directly visible to the user. Interference-based images may also be arranged on this side by means of printing techniques. An image of this kind may also 30 be arranged on that side of the label which is to adjoin the substrate, for example situated between the hole 6 and that part of the surface which is provided with writable/readable material. It is also possible to arrange semiconductor chips 7 on the label, by means of which chips the protection of the information carrier is further improved.

35 Fig. 2 shows part of a DVD. This DVD is denoted overall by 10 and comprises a substrate 12 having a thickness of, for example, 0.6 mm. The label 13 according to the invention is applied to this substrate. This application takes place in the above-described manner, i.e. firstly label 13 is placed in a mould cavity, then polycarbonate material or

another plastic, such as PMMA, which forms the substrate 12, is injected onto this label. In this particular case, label 13 is provided with a layer of visible information 11. This layer 11 is present when placed into the mould cavity. It is also possible to print interference-based 5 patterns on the label, on the other side from the one on which the visible image is arranged.

After the assembly comprising label 13 and substrate 12 has been produced, the optical information carrier part 15 is joined thereto. This optical information carrier part is produced by injection-moulding 10 in a manner known in the prior art.

This consists, for example, in producing a part 18, which is approximately 0.6 mm thick and is provided with the important optical information, by injection-moulding. A layer 14 which is essentially impermeable to the light used is then applied by a sputtering technique. 15 Layer 17 provides for the attachment of the assembly comprising substrate 12 and label 13 and the optical information carrier part 15. It is also possible, for embodiments other than the embodiment shown in Fig. 2, to provide layer 14 with one or more optically readable layers by applying translucent 2P-resin which is provided with an optically readable pattern 20 by means of compression-moulding techniques. A layer formed in this way can then be provided with a (selectively) reflecting layer.

Fig. 3 shows a DVD denoted overall by 20. In this embodiment, both the optical information carrier part 25 and the further optical information carrier part are provided with optical information. In this 25 case, the label comprises plastic carrier 23, on which there are a layer 21 with visible information on one side of the label and a layer 29 with optically readable properties on the other side. A reflecting layer 24 is arranged on layer 29. Substrate 22 is injection-moulded against this label in accordance with the above-described invention. In another 30 production step, an information carrier part is produced in a manner known from the prior art, comprising a substrate 28 and a (selectively) reflecting layer 26. In a subsequent production step, the two information carrier parts are joined together by means of a light-transmitting layer 27. It is also possible for information carrier 20 to be produced such 35 that information carrier part 25 is provided with more than one optically readable layer, by applying to layer 26 a photoreactive polymer on which an optically readable pattern is produced by means of printing techniques. This pattern is furthermore provided with a reflecting layer 24. The information carrier part formed in this way is joined to a part

produced in accordance with the invention comprising at least label 23 and substrate 22. Naturally, it is possible to produce the structure shown here in other ways, but it is essential to the invention that part 23 be joined to substrate 22 by injection-moulding. Layers 24 and 26 may 5 in this case be designed to be less permeable to some kinds of light and more permeable to other kinds of light. In this way, it is possible to read the DVD shown in Fig. 3 from one side using two light sources which emit light at different frequencies. It is also possible to employ a lens assembly having at least two different focal point distances, thus 10 reading information at different depths.

The embodiment in accordance with Fig. 4 corresponds to that which is shown in Fig. 3, except that layer 33 is impermeable to the light employed, so that the DVD shown in Fig. 4 is to be read from two sides. In Fig. 4, the DVD is denoted overall by 30. The label comprises a 15 carrier 33 and an optically readable layer 39, applied by lithography, which has a reflecting layer 34. This label is firstly placed in an injection mould, after which a substrate 32 is applied against layer 34 by injection-moulding in accordance with the above-described process. It is possible to provide layer 34 with a protective layer 31 beforehand. It 20 is also possible for label 33 in this process to be provided with an adhesive layer 37 beforehand. The optical information carrier part formed in this manner is joined to a further optical information carrier part 35 produced in a manner known in the prior art.

The most complicated embodiment is shown in Fig. 5 and denoted 25 overall by 40. This DVD comprises an optical information carrier part 45 having a thickness of, for example, 0.6 mm, and a further optical information carrier part which is produced in accordance with the invention. The label comprises a plastic carrier 43 on which two information layers have been arranged by compression-moulding techniques. 30 These layers comprise a 2P-resin 49 and are provided with an optically readable structure by means of compression-moulding. Layer 44 is reflective and layer 46 is selectively reflective. A protective layer or adhesion layer is arranged on 46. The label is firstly placed in an injection mould, whereupon a substrate 42 is applied against layer 46 by 35 injection-moulding in accordance with the above-described invention. The optical information carrier part formed in this way is joined to a further optical information carrier part 45. It is essential here that the label 43 adjoins the reflecting layer 44 of information carrier part 45 by means of an adhering layer 47. Information carrier part 45 is

formed in the manner described with reference to Fig. 3. This entails providing an information carrier part, comprising a substrate 48 with an optically readable layer 46, with a photoreactive polymer (2P-resin) on which a second optically readable layer 44 is formed by means of 5 compression-moulding. In this case, layer 46 is selectively reflective and layer 44 is completely reflective. The information carrier formed in this manner is to be read on both sides.

It will be understood that the capacity of the CD or DVD in question rises as the number of layers of optical information increases. 10 The information-carrying layers can be produced and finished in any manner known in the prior art, such as by sputtering. Protective layers may be applied in the conventional centrifugal manner, such as by spin-coating. It will be clear that the above merely relates to a few exemplary embodiments of the invention, and that numerous variants which 15 fall within the scope of the appended claims are conceivable to the person skilled in the art.

CLAIMS

1. Process for producing a disc-shaped optical information carrier, provided with a central opening and optically readable information which is arranged (can be arranged) around this opening, comprising the provision of a substrate and the arrangement thereon of readable information, the substrate being produced by injection-moulding, characterized in that this readable information is arranged on a label (3, 13, 23, 33, 43), this label is placed in the cavity of an injection mould, followed by the full injection of this cavity with the material for the substrate.
2. Process according to Claim 1, the label being provided with readable/writable characteristics before being placed in the mould cavity.
3. Process according to Claim 2, the label being provided with visible and/or decipherable encrypted information before being placed in the injection mould.
4. Process according to one of the preceding claims, the assembly comprising substrate and label being joined to an optical information carrier part, the label being placed between the substrate and the optical information carrier part.
5. Process according to one of the preceding claims, the label being provided with an (activatable) adhering layer before being placed in the mould cavity, which layer is arranged towards the edge of the cavity, away from the material to be injected.
6. Disc-shaped information carrier (1, 10, 20, 30, 40) provided with a central opening (6) and optically readable information arranged around this opening, comprising a label (3, 13, 23, 33, 43), against which a substrate (2, 12, 22, 32, 42) is arranged by injection-moulding.
7. Information carrier according to Claim 6, an optically writable/readable medium (4) being arranged on the label.
8. Information carrier according to Claim 6 or 7, which is provided with a label on which visually apparent and/or encrypted images (11, 21) are arranged.
9. Information carrier according to one of Claims 6-8, which is provided with a label on which one or more semiconductor chips (7) is/are arranged.
10. Information carrier according to one of Claims 6-9, comprising an information carrier part (15, 25, 35, 45) arranged against the free

side of the label, the said optical information carrier part and/or substrate comprising a layer (18, 28, 38) provided with the optical pattern and a light-impermeable (14, 36) (or selectively light-transmitting) layer (26, 36) arranged thereon and a protective layer or 5 adhesive layer (18, 28, 38, 48).

11. Information carrier according to Claim 10, two 2P-layers (49) being arranged on one side of the label, with a completely reflective layer (44) being arranged on the first 2P-layer and a selectively reflecting layer (46) on the second 2P-layer.

Fig - 1

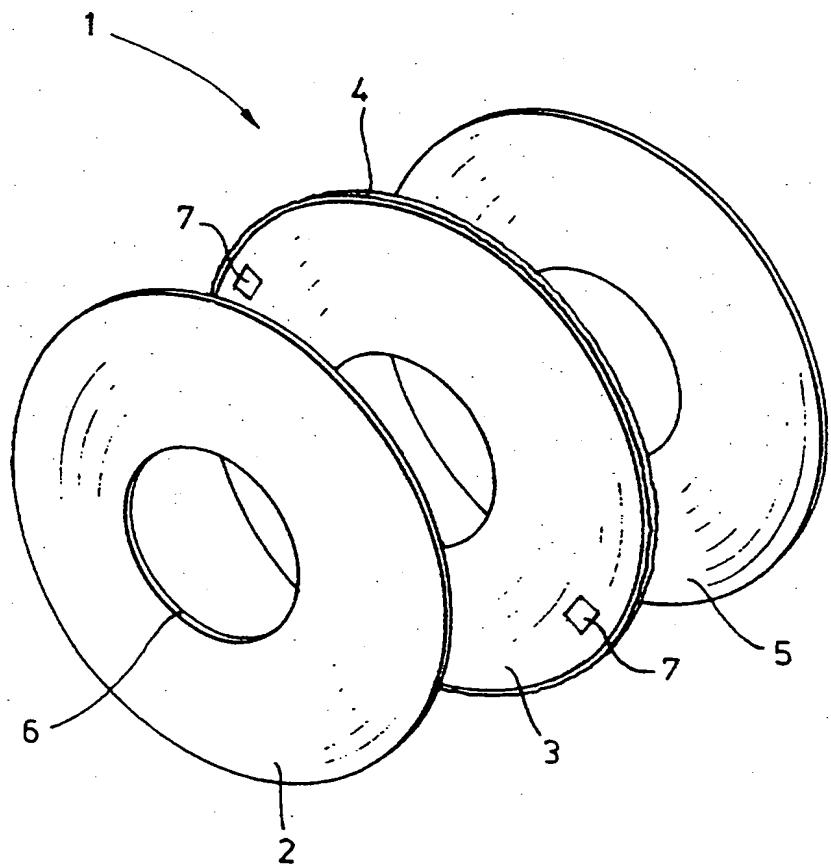


fig - 2

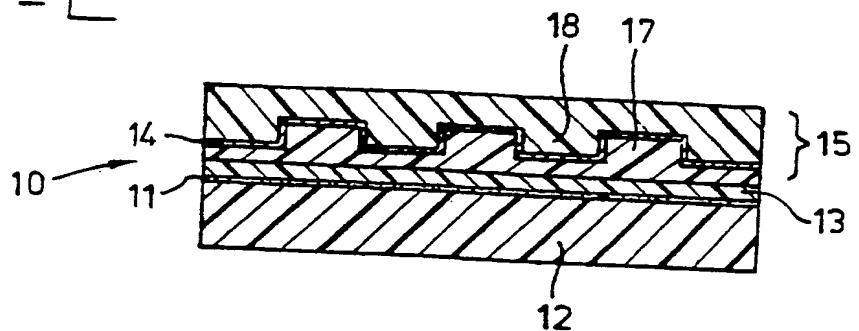


fig - 3

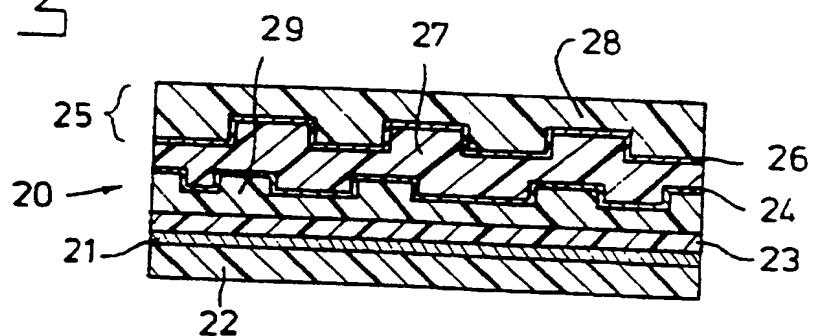


fig - 4

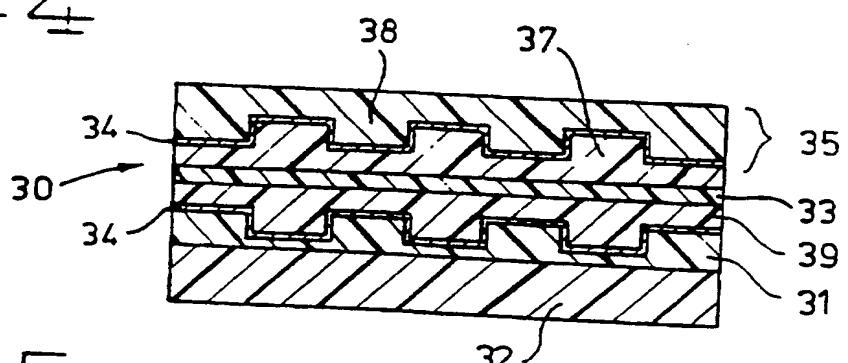
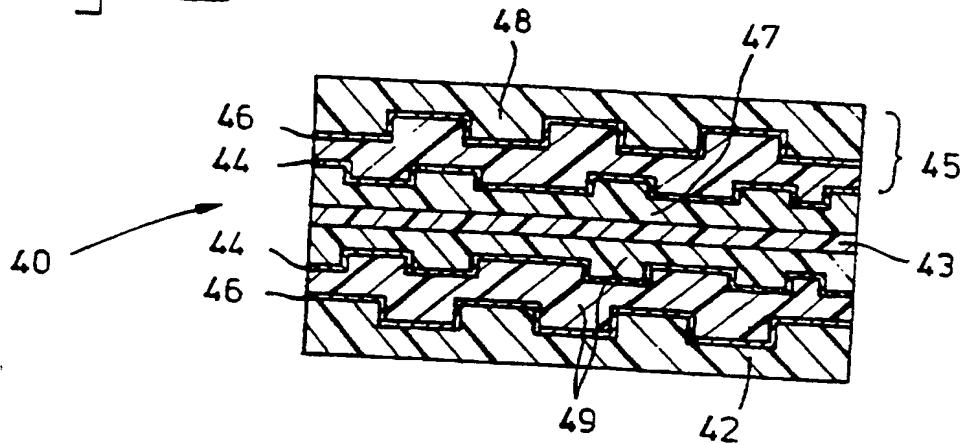


fig - 5



INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 97/00245

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 6 G11B7/26 B29C45/26 B29D17/00 G11B23/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 IPC 6 G11B B29C B29D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 43 02 384 A (VICTOR COMPANY OF JAPAN) 29 July 1993 see abstract; figures 1,4 ---	1,2,7,8
A	EP 0 704 843 A (DIGIPRESS) 3 April 1996 see claims 1-3; figure 2; example 1 ---	1,2,7,8
A	PATENT ABSTRACTS OF JAPAN vol. 014, no. 025 (P-991), 18 January 1990 & JP 01 264639 A (HITACHI LTD), 20 October 1989, see abstract ---	1,2,7,8
A	WO 94 10684 A (PMDC INC ; WISE JAMES SCOTT (US); MCBRIDE RANDALL RAY (US); HARDEN) 11 May 1994 see abstract; figure 1 ---	1,2,7,8
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Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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